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THE CHEMICAL COMPOSITION OF GREEN SPROUTED OATS. FISH WASTES FOR FEEDING ANIMALS.

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THE CHEMICAL COMPOSITION OF GREEN SPROUTED OATS.

J. M. BARTLETT.

Green sprouted oats have been widely exploited in recent years as a succulent food for poultry. Indeed, there are some so-styled "Poultry systems" on the market which consist of little else than the use of this food. The Maine Station has been using sprouted oats in its poultry studies for a number of years. The method of sprouting devised by the Station was published in a bulletin that is now out of print. But it is reprinted in detail in "Poultry Management at the Maine Station." The essential points are outlined below.

The poultry investigations of this Station, for the most part bear only incidentally on food studies and the average of published analyses are sufficient for this purpose. In the earlier work the analyses of unsprouted oats were used in computing the rations, but as the amount of sprouted oats in the ration used at the Station were considerably increased it became desirable to know more concerning the composition of sprouted as compared with unsprouted oats. For this reason the studies here reported were undertaken.

THE PREPARATION OF SPROUTED OATS.

The first experiments with this material at the Maine Agricultural Experiment Station were not satisfactory. It was found difficult to get the oats to make a sufficiently quick growth. Experience here has indicated that in order to make a satisfactory green food the oats must be grown very quickly. In order to get quick growth it is necessary to have three things:—warmth, plenty of moisture, and sunlight.

A tight closet provided at the bottom with steam or hot water heating pipes, glass doors open to the south in a sunny room, and suitable trays for the thoroughly moistened grain furnish these three essentials. At the Station the trays are $2\frac{1}{2}$ feet square and 2 inches deep inside. The closet can be of a capacity suited to the size of the poultry plant. The closet at the Station holds 12 trays in 3 tiers with 15 inches in height between the trays. The trays are made of wood and have holes bored in them to allow surplus water to drain off.

The only difficulty with which one has to contend is the matter of mold. There is always a tendency for the oats to mold in the sprouting process. The only way in which it has been found possible to control this mold is by thoroughly cleaning the trays after each time when they are used. After a tray has been emptied it is thoroughly scrubbed with a 50 per cent solution of commercial formaldehyde (that is, equal parts of commercial formaldehyde and water." Enough formaldehyde is used to soak the tray well. With this precaution, and if the oats are further made to grow rapidly, the mold does not give any trouble whatever.

The actual method of sprouting the oats is as follows: Clean and sound oats are soaked in water over night in a pail. The next morning the trays are filled to the depth of about 2 inches, and put into the sprouting closet. At the beginning freshly filled trays are placed near the top of the closet so as to get the maximum amount of heat, and in that way get the sprouts started at once. During the first few days, until the sprouts have become from a half to three-quarters of an inch long, the oats are thoroughly stirred and raked over 2 or 3 times during the day. This stirring insures an even distribution of moisture throughout the mass of oats in the tray. After the sprouts become sufficiently long so that the oats form a matted mass it is not desirable to stir them, or to disturb them in any way.

The sprouting oats need plenty of water and should be wet 3 times a day. This is readily done with an ordinary greenhouse sprinkling can, with little expenditure of time or labor. As the oats grow the trays are moved to different positions in the closet. The taller the green material gets, the nearer the trays are moved towards the floor, because the growing grain

then needs less heat. This procedure leaves the desirable places in the closet for the grain just beginning to sprout where high temperature is needed.

The oats are fed when they are from 4 to 6 inches in height. They are fed at the rate of a piece of the matted oats and attached green stalks about 6 to 8 inches square for each 100 birds per day.

THE COMPOSITION OF SPROUTED OATS.

The analyses of the sprouted oats were made at different stages of growth and in such a way that it was possible to compare the nutritive value of the sprouted with the unsprouted oats. Two experiments were carried out. In experiment 1 the oats were sprouted in the closet described above. In experiment 2 the oats were sprouted in glass dishes to avoid any possible loss from drainage.

EXPERIMENT I.

Four lots of 3000 grams of oats each were soaked over night, and put in trays in the sprouting closet. At the end of 48 hours, tray No. 1 was taken out, the oats weighed, thoroughly mixed and a sample taken and dried for analyses. The sprouts at this time were from $\frac{1}{4}$ to 1 inch long. After 2 days more tray No. 2 was taken out and treated the same as No. 1; the sprouts were from 2 to 3 inches long and roots had begun to form. At the end of 2 more days tray No. 3 was removed, weighed, and sampled the same as No. 1 and No. 2. At this time the tops were 2 to 3 inches high and the whole mass of oats was matted together with roots. The fourth tray was allowed to stand 2 days longer when the whole tray was covered with a dense growth of tops, many blades being 6 inches high. These plants had made more growth than is usually allowed. A section from this tray was weighed separately and the tops cut close to the roots and analyzed alone. The results of the analyses of all the trays are given in the following tables.

This Table Shows the Composition of the Oats Used, and Sprouted Oats at Different Stages of Growth.

Oats and Sprouted Oats	Water	Ash	Crude Protein	Albuminoid Nitrogen x 6.25	Crude Fiber	Nitrogen Free Extract	Fat	Starch by Acid Method	Sugar
	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Oats used.....	10.35	2.85	9.88	8.25	8.97	41.14	5.03	52.88	1.74
Tray 1-2 days...	55.60	1.33	5.11	4.13	4.84	30.75	2.38	26.33	1.55
Tray 2-4 days...	67.31	0.96	3.69	3.16	3.73	22.55	1.76	16.69	1.72
Tray 3-6 days...	76.55	0.74	2.83	2.21	2.93	15.58	1.36	9.93	2.59
Tray 4-8 days...	78.71	0.73	2.75	2.13	3.24	13.32	1.25	6.75	3.43
Tops from tray 4.....	90.85	0.46	2.27	1.43	1.66	4.98	0.57	1.20	1.30

This Table Shows the Composition of the Oats, and the Sprouted Oats on Water Free Basis.

	Ash	Crude Protein	Albuminoid Nitrogen x 6.25	Crude Fiber	Nitrogen Free Extract	Fat	Starch by Acid Method	Sugar
	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Oats	3.18	11.03	9.24	10.03	70.15	5.61	58.98	1.94
Tray 1	3.00	11.51	9.30	10.89	69.23	5.37	59.30	3.48
Tray 2	2.94	11.27	9.66	11.41	68.99	5.39	51.06	5.26
Tray 3	3.15	12.07	9.42	12.51	66.48	5.79	42.35	11.06
Tray 4	3.41	12.89	9.99	15.24	62.59	5.87	31.72	16.09
Tops from tray 4.....	4.99	24.76	15.57	18.18	45.89	6.18	13.08	19.64

This Table Shows the Amount of Nutrients in the Oats and Sprouted Oats at Different Stages of Growth.

	Dry Matter	Ash	Crude Protein	Albuminoid Protein	Crude Fiber	Carbo-hydrate	Fat	Starch	Sugar
	grams	grams	grams	grams	grams	grams	grams	grams	grams
Oats	2689.5	85.5	296.7	248.5	269.1	190.1	150.9	1587.0	52.1
Tray 1 2 days...	2419.3	72.6	263.5	225.3	263.8	1676.0	130.0	1436.0	84.2
Tray 2 4 days...	2500.	73.6	282.0	241.6	285.6	1726.0	135.0	1278.0	131.6
Tray 3 6 days...	2350.6	74.1	284.0	221.7	294.3	1563.5	136.1	996.0	259.0
Tray 4 8 days...	2239.5	76.4	288.7	223.8	341.2	1402.0	131.5	710.2	360.4
Tops of Tray 4	129.20	6.5	29.8	18.6	21.8	54.9	7.4	15.7	23.4

EXPERIMENT NO. 2.

A second experiment was undertaken in glass dishes as it was thought that possibly some leaching might take place in the wooden trays which were provided with drainage, it being impossible in practice not to add an excess of water and be sure that enough had been added to wet all the oats. Four covered glass crystalizing dishes were used for the purpose. Two hundred grams of oats were put in each dish and treated as nearly as possible the same as those sprouted in the trays but only enough water was added to keep the oats moist. At the laboratory temperatures the sprouting did not go on as rapidly as it did in the sprouting closet and about 3 days were allowed between each sprouting. In the fourth sprouting the tops were about 3 to 4 inches high, about the size that they are ordinarily fed. The results are given in the following tables.

This Table Shows the Composition of Oats and Sprouted Oats Sprouted in Glass Dishes, Calculated to Water Free Basis.

	Ash	Protein		Crude Fiber	Carbo-hydrate	Fat	Starch Acid Method	Sugar
	percent	per cent		percent	percent	percent	percent	percent
Oats	3.90	11.67	8.73	69.43	6.27	57.0	45.7	3.19
First sprouting, 3 days	3.27	12.52	8.04	69.83	6.34	54.8	43.7	3.66
Second sprouting, 6 days	3.50	11.95	11.12	67.03	6.40	43.5	41.1	7.64
Third sprouting, 8 days	3.67	12.86	10.90	66.30	6.27	42.2	34.5	7.95
Fourth sprouting, 11 days	3.80	13.66	12.33	64.53	5.63	31.9	24.4	13.1

This Table Shows the Amount of Dry Matter and Nutrients in the Oats and Sprouted Oats at Different Stages of Growth in Glass Dishes.

	Dry Matter	Ash	Protein	Fiber	Nitrogen Free Extract	Fat	Starch Acid Strength	Sugar
	grams	grams	grams	grams	grams	grams	grams	grams
Oats -----	180.0	7.02	21.00	15.7	125.3	11.28	102.6	5.72
First sprouting -----	166.9	5.45	20.9	13.4	116.6	10.53	91.7	6.11
Second sprouting ----	170.0	5.98	20.3	18.9	114.0	10.88	73.96	12.99
Third sprouting -----	154.2	5.65	19.83	16.81	102.2	9.66	65.1	12.26
Fourth sprouting ----	151.9	5.69	19.75	18.48	97.45	8.44	47.85	19.62

An inspection of the figures in the tables shows a loss of material in all the different stages of growth. There is a larger loss of dry material in tray No. 1 where only very little growth has been made than in tray No. 2 where considerable more growth had been made and some roots formed. In the wooden trays to which a liberal amount of water was applied it was thought that the loss might be due to leaching but the same thing occurred in the glass dishes where no leaching occurred and the loss could not be accounted for in that way.

Trays No. 3 and 4 represent about the usual sizes that oats are grown to feed out, consequently the average analyses of these two trays would probably be nearer the true composition of sprouted oats as usually used in practise than any one of the trays alone. The average analyses of these two trays shows a loss of dry matter of 14.5 per cent, crude protein 3.5 per cent, protein calculated from albuminoid nitrogen 9.6 per cent, nitrogen free extract (starch, sugar, etc.) 27.2 per cent and fat 12.8 per cent. The greatest loss was in starch but that was partly made up by the increase in sugar.

SUMMARY.

Sprouted oats at the proper stage to feed will carry about 77 per cent of water, 2.8 per cent protein, 3 per cent crude fiber, 1.3 per cent fat and 16 per cent nitrogen free extract.

There is an actual loss of dry matter in sprouting oats and the only advantage of the process is to produce a succulent green food at times when grass or other green foods are not available.

FISH WASTES FOR FEEDING ANIMALS

J. M. BARTLETT

The increasing demand for animal foods together with the high price and scarcity of beef scraps (which has been the chief supply in the past) has forced dealers and consumers of these materials to look to other sources for a supply. Fish waste or fish of any kind has been known always to be highly relished by meat eating animals and to produce excellent results in growth or egg production. The great objection to its use in large quantities has been the tendency to give the flesh or eggs a fishy flavor which is known to be very pronounced in water fowl that live largely on fish. Late investigations have shown that the fishy flavor is due largely to fish oil and when that is quite completely removed as it is now in some fish meals that have appeared on the market the material can be used in much larger quantities without imparting a disagreeable flavor to the product. In Europe waste fish products have been used for feeding animals for several years. Spier of Scotland reports no bad influence on milk when reasonable quantities of dried fish are fed to dairy cows, and in Germany, the better grades of dried fish waste have been used for feeding hogs, cattle and poultry for many years. Experiments conducted at the Experiment Station in Harlshausen, indicate that fish meal forms a desirable supplementary feeding stuff for farm animals especially for pigs. It was found that if fed in too large quantities or contained too high percentages of oil it would produce a fishy taste to the meat product, but meal containing only 2 percent to 4 percent of oil could be safely fed. The phosphate of lime found in the meal is deemed a valuable adjunct in feeding animals. The fish waste should not contain more than 3 percent of salt. It is recommended to feed as high as 2 pounds to 1000 lb. cows and one fourth to one half pound to pigs, depending on their size.

Large quantities of fish wastes are produced along the Maine Coast every year and these, in the main, have been sold to fertilizer companies in the raw condition. Much of this

material if it could be properly handled would be valuable food for animals and a very good substitute for beef scrap. Below are given several analyses of waste materials from sardine factories, which have been recently received from parties interested in their value as food and fertilizer.

Table Showing the Composition of Fish Wastes from Sardine Factories as they were Received.

		Water	Nitrogen	Total Phos. Acid	Protein N x 6.25	Fat	Ash*
579	So-called mush or chum as it comes from packers tables	70.88	2.54	1.69	15.88	7.99	5.91
580	Rendered material from Sardine factory	10.46	8.19	5.75	51.19	20.91	17.36
581	Chum from sardine factory, dried and ground	12.84	7.46	6.76	46.63	19.69	19.36
582	Herring pomace from sardine factory. Steamed and pressed	48.02	4.60	2.37	28.75	9.09	12.52
583	Pomace from head and trimmings of alewives	44.92	4.50	4.31	28.13	8.44	15.67

*Chiefly phosphate of lime.

Table Showing the Nutrients in the Fish Wastes from Sardine Factories when Air Dry.

		Water	Ash	Protein N x 6.25	Fat
579	So-called mush or chum as it comes from packers tables	12.02	17.84	43.93	24.15
580	Rendered material from Sardine factory	10.46	17.36	51.19	20.91
581	Chum from sardine factory, dried and ground	12.84	19.36	46.63	19.36
582	Herring pomace from sardine factory. Steamed and pressed	10.00	21.60	50.02	14.70
583	Pomace from head and trimmings of alewives	10.00	25.50	46.80	13.83

The above samples show a great variation in composition (in the first table) due, largely, to the variation in water content. When reduced to an air dry condition carrying approximately ten percent of water the variation in composition is not very great. The water content of a meal should not be much above 10 percent to have good keeping qualities. These samples show a large food value, but the oil content is too high to be safe to fed except in small quantities.

